

# Lumbar radiculopathy: Outcome analysis following treatment by only fixation – A report of an early experience of 44 cases

## ABSTRACT

**Objective:** An alternative novel form of surgical treatment for patients having prolapsed or bulging intervertebral disc, with or without associated osteophyte, related lumbar radiculopathy by “only fixation” or internal orthosis and aiming for segmental arthrodesis is presented.

**Materials and Methods:** During the period July 2014–October 2018, 44 patients presenting with symptoms of lumbar radiculopathy and diagnosed to have bulging, prolapsed or herniated lumbar intervertebral disc with or without associated osteophytes were treated by only spinal stabilization without resorting to any kind of bone, ligaments, osteophyte, or disc resection.

**Results:** All patients had “immediate” postoperative relief from radicular symptoms. The Visual Analog Scale and the Oswestry Disability Index scores were used to assess the patient both before and after the surgical treatment. During the follow-up period that ranged from 10 to 60 months (average: 35 months), there was no recurrence of symptoms. Complete or significant resorption of the herniated disc was seen in 29 cases on follow-up radiological assessment.

**Conclusions:** Spinal segmental fixation without any manipulation of the herniated disc or osteophyte and without any kind of bone or soft-tissue decompression is a safe, effective, and rational method of treatment of lumbar radiculopathy related to intervertebral disc herniation.

**Keywords:** Lumbar intervertebral disc, osteophyte, radiculopathy, spinal instability

## INTRODUCTION

Lumbar radiculopathy related to intervertebral disc herniation is a common ailment worldwide and has been treated by a number of surgical and nonsurgical methods. Resection of the herniated disc and widening of the spinal and/or neural canal by bone decompression and osteophyte resection are established and accepted forms of surgical treatment.

The universal recommendation of “complete bed rest” and advice for the use of external lumbar orthosis are popular techniques of conservative treatment for acute prolapsed or herniated intervertebral disc. Intermittent lumbar “traction” is also one of the accepted and time-tested therapeutic modalities. The success of conservative or nonsurgical treatment in providing relief from symptoms and subsequent resorption of the herniated component of the prolapsed

disc is a well-described and commonly encountered clinical phenomenon. Failure of such conservative treatment is the more common indication for the need for surgical intervention. The fact that avoidance of spinal movements with or without immobilization of the back by external

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methods of spinal stabilization results in symptomatic relief indicates the role of dynamic component or “spinal instability” as a cause of symptoms. We identify the role of “only fixation” or “internal orthosis” of the spinal segments as an effective form of treatment for prolapsed or herniated intervertebral disc. No decompression by removal of bones, osteophytes, soft tissues, or prolapsed lumbar intervertebral disc was done. The “zero” local movement provided by transarticular technique of fixation is impossible to achieve by any external immobilization technique and even by most internal fixation techniques that deploy metallic implants. Results of such surgical treatment are analyzed. We earlier described a similar form of treatment for disc prolapse and osteophyte compression-related cervical radiculopathy<sup>[1]</sup> and for prolapsed or extruded disc-related cervical myelopathy.<sup>[2,3]</sup> We also described the role of “only fixation” for the treatment of single- or multilevel cervical and lumbar canal stenosis.<sup>[4-9]</sup>

## MATERIALS AND METHODS

During the period July 2014–October 2018, 44 patients having a single-level prolapsed lumbar disc with or without associated osteophyte and presenting with symptoms related to radiculopathy were surgically treated at the author’s institutes. The analysis of the consecutively treated patients is retrospective. All the patients provided written informed consent before surgery, and all clinical tests and surgical procedures were conducted according to principles of the 1975 Declaration of Helsinki and its amendments. The procedures performed were in accordance with ethical standards of the institutional ethics committee. The study is a retrospective analysis of data, and previously published and established surgical techniques of spinal fixation were deployed. The issues related to the fixation procedure over the conventional decompression surgery were discussed with the patients. Patients having radiological or clinical manifestations that suggested multisegmental spinal canal compression or lumbar canal stenosis were excluded and have been analyzed elsewhere.<sup>[6,9]</sup> Patients operated by any other surgical technique prior to being treated by authors’ surgical unit have been excluded.

There were 34 males and 10 females and their ages ranged from 32 to 75 years (average: 45 years). The time from symptom onset to surgical treatment is shown in Table 1. The indications for surgery were as per standard and described norms. All patients failed conservative treatment by “complete” bed rest, external orthosis, local and systemic analgesics, or nonscientific medication for a minimum period of 4 weeks. Table 1 depicts the clinical presenting symptoms and neurological findings. Grading of clinical symptoms was

essentially done as per the Visual Analog Scale (VAS) index and the Oswestry Disability Index (ODI) and is detailed in Tables 2 and 3. In 32 patients, it appeared that the posterior longitudinal ligament was intact (contained disc), while in 12 patients, it appeared that the disc extruded out of the confines of the posterior longitudinal ligament (extruded disc). In 9 patients, an associated lateral osteophyte-related neural deformation was identified to be the cause of radiculopathy.

## Surgical technique

All patients underwent segmental spinal stabilization by deploying the transarticular method of fixation as described by Camille and Saillant in 1972.<sup>[10]</sup> Two screws were deployed at each articulation by transarticular technique (double-insurance technique).<sup>[11]</sup> In ten articulations, three screws (triple insurance) were used. The number of levels fixed depended on direct and real-time inspection of the status of the facets and the articulation and manual manipulation of the bones of the region to assess their stability. The observations regarding stability of the spinal segments were based on clinical presenting features and assistance of radiological indicators. In 18 patients, only one-level spinal fixation was done. More than 1 level of facet

**Table 1: The clinical and radiological features**

Clinical features	Number of patients
Back pain	44
Radicular pain	44
Motor/sensory deficit	6
Duration of symptoms before surgery	4 weeks-6 months (mean-64 days)
Radiological level involved	
L3-L4	5
L4-L5	24
L5-S1	15
Number of levels fixed	
Single level	18
Two levels	23
Three levels	3

**Table 2: The pre- and postoperative Visual Analog Scale (0 - no pain and 10 - maximum pain)**

VAS score	Preoperative	Postoperative (3 months)	Postoperative (6 months)
Radicular pain	6.9 (4-9)	1.4 (0-2)	0.1 (0-1)

VAS – Visual Analog Scale

**Table 3: The pre- and postoperative Oswestry Disability Index**

ODI score	Preoperative	Postoperative (6 months)
0%-20%: Minimal disability	-	44
21%-40%: Moderate disability	6	-
41%-60%: Severe disability	29	-
61%-80%: Crippled	9	-
81%-100%: Bedridden	-	-

ODI – Oswestry Disability Index

fixation was done in 26 patients despite the fact that disc herniation or osteophyte-related neural compression was observed essentially at one level.

Bone graft was harvested from the spinous processes by sharply sectioning them at the base. The spinous process bone was then shredded into multiple pieces and was placed in the interlaminar space and available space on the posterior face of facets around the screws after appropriately preparing the host bone area. Removal of all intervertebral ligaments and soft tissues and drilling of the outer cortex of the laminae prepared the host bone for arthrodesis. The patients were advised to wear lumbar belt for a period of 6 weeks and to limit physical activities that involved bending the back during the period.

## RESULTS

All patients showed “remarkable” or complete recovery in radicular symptoms in the immediate postoperative period [Table 2]. Relief from all symptoms and pain-free leg movements were observed after full recovery from anesthesia. The improvement was sustained at the follow-up that ranged from 10 to 60 months (average: 35 months). The VAS and ODI were recorded 6 months after surgery and are shown in Tables 2 and 3. All patients remained essentially symptom free. At a follow-up of more than 6 months, the herniated disc regressed significantly or could not be seen on imaging in 29 patients [Figures 1-4]. Successful fusion of the spinal

segments was defined as the presence of evidence of fusion of the facets and absence of the lining of articular cartilage, absence of motion and alterations in the interspinous process, and intervertebral body distances on flexion-extension radiographs. Based on this criterion, successful fusion was obtained at all the treated spinal levels. Solid fusion of the posterior elements of the fixed vertebrae was seen in patients with follow-up longer than 12 months. There were no complications related to surgery and to the implant. No patient has needed any reoperation for the lumbar spine.

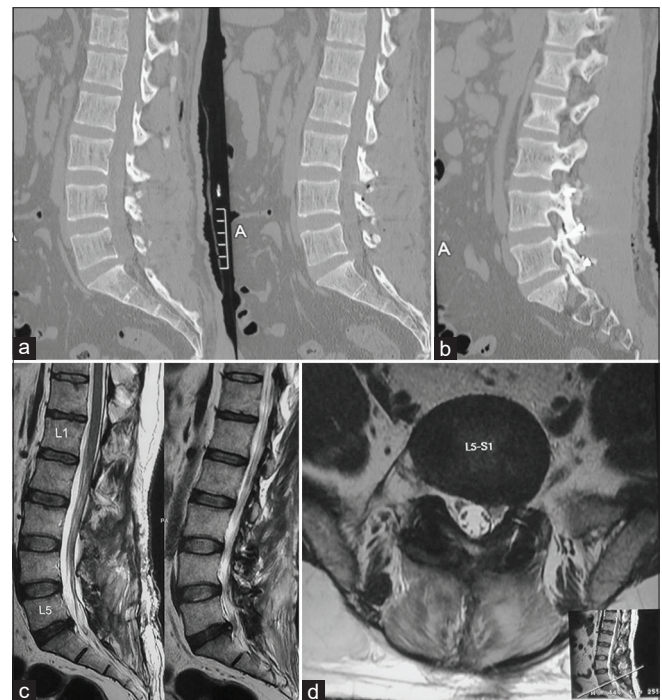
As relatively simple instrumentation was used, the time required for the surgical procedure was significantly less when compared to other surgical techniques described for the treatment of lumbar disc. Intraoperative fluoroscopy was unnecessary. Moreover, the cost of the implants was relatively low.

## DISCUSSION

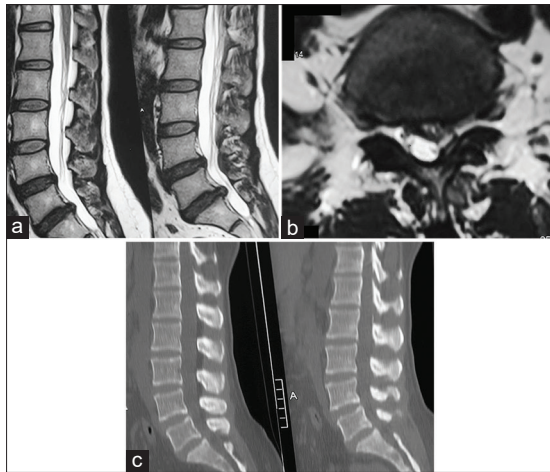
Surgery for lumbar disc herniation is the most frequently performed spinal operation. Lumbar disc herniation affects approximately 3 million people every year in the United States of America.<sup>[12-14]</sup> Although figures are not available from India,



**Figure 1:** Preoperative images of a 35-year-old male patient, (a) T2-weighted magnetic resonance imaging showing a large L5-S1 disc herniation. (b) Axial image of magnetic resonance imaging showing disc herniation. (c) Computed tomography scan of the lumbar spine



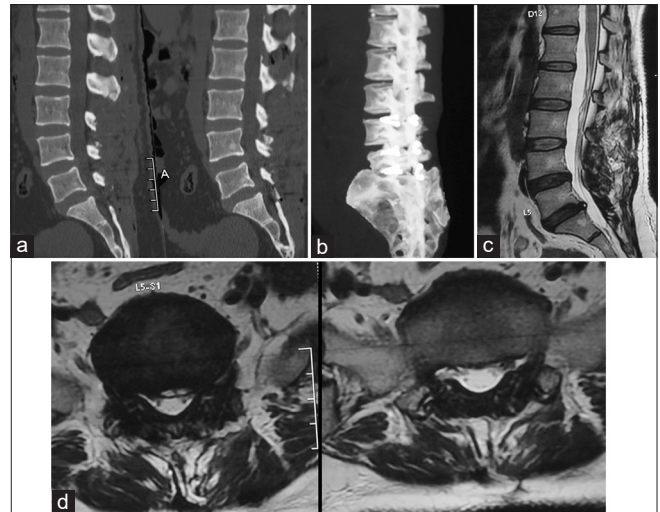
**Figure 2:** Postoperative images. (a) Postoperative computed tomography scan of the lumbar spine showing sectioning of the spinous processes. Bone graft pieces are seen in the midline. No other part of bone has been removed. (b) Postoperative computed tomography scan showing transarticular screws at L3-4, L4-5, and L5-S1 levels. (c) Postoperative magnetic resonance imaging (3 months after surgery) showing resorption of the herniated disc. (d) Axial magnetic resonance imaging image showing resorption of the herniated disc



**Figure 3: Preoperative images of a 44-year-old female patient. (a) T2-weighted magnetic resonance imaging showing L5–S1 herniated disc. (b) Axial image of magnetic resonance imaging showing disc herniation. (c) Preoperative computed tomography scan**

it does seem that the number of patients affected by such ailment is proportionate. Considering the extent of public health issue, it is mandatory that there is a constant evaluation of the existing treatment forms. Severe and disabling pain and symptoms of radiculopathy such as tingling paresthesia and numbness and relatively less frequently weakness and wasting of affected myotomes are the presenting hallmarks of prolapsed lumbar intervertebral disc. There is little controversy about the indications and strategy of treatment. When the symptoms are marginal or are improving, a conservative nonsurgical treatment is preferred that involves supervised and structured clinical observation and a regimen of complete bed rest and firm immobilization using external lumbar orthosis. Failure to achieve symptomatic relief with such techniques is generally identified to be a suitable indication for need of surgical intervention.

Surgery on herniated intervertebral disc with or without associated osteophyte-related lumbar radiculopathy constitutes one of the safe, relatively “simple,” and gratifying operations where the symptomatic relief is instant and permanent. Moreover, frequently, a large amount of seemingly “dead” disc material can be removed, and the entire region can be visually seen to be relaxed and nerve root can be seen to be released of stretch. The primary aim of the surgical treatment has been to decompress the nerve root from compressing bone, osteophyte, or disc and allow a stretch-free traverse. The familiarity of most surgeons with lumbar discectomy surgery is an additional advantage. Despite the fact that the surgery is relatively simple and straightforward, complications of dissection-related injury to nerve root/s are common. Considering the fact that postoperative instability-related symptoms are known



**Figure 4: Postoperative images. (a) Postoperative computed tomography scan showing sectioning of the spinous processes. Bone graft pieces are seen placed in the midline. (b) Computed tomography scan showing double-insurance screw insertion at each articulation for three spinal levels. (c) Postoperative magnetic resonance imaging (6 months after surgery) shows almost complete resorption of the herniated disc. (d) Axial images of magnetic resonance imaging showing disc resorption**

after disc resection and also that the long-term outcome of herniated disc is generally recognized to be interbody fusion, several surgeons recommend instrumented fixation and arthrodesis of the spinal segments.

Despite the fact that the treatment protocol is more or less standardized, it appears that the last word is still to be said. A number of posterior, lateral, anterolateral, and anterior surgical approaches have been discussed for resection of the herniated disc and interbody fusion.<sup>[15]</sup> Posterior “microdiscectomy” is probably the current gold standard treatment for lumbar disc herniation. More recently, percutaneous endoscopic discectomy and tubular retractor-assisted discectomy have been identified as safe alternatives. While the modalities of achieving the goal of neural “decompression” have changed over the years and minimal invasive surgical forms are becoming more popular, the basic surgical concept has not significantly altered. Spinal fixation using instrumentation after decompression for radiculopathy has been occasionally suggested but has not achieved universal acceptance, more particularly for a single-level disc herniation. The issue of resection of only the herniated part of the disc, partial disc resection, or resection of the entire disc is also debated. It is generally agreed that the long-term outcome of untreated or nonsurgically treated disc prolapse is resorption of the herniated part and also of the seemingly intact disc and the ultimate outcome is intervertebral body bone fusion. Movement-preserving options that include the introduction of artificial disc are currently being extensively evaluated.

In the year 2010, we proposed a concept that “vertical” spinal instability manifested by listhesis of the inferior facet of rostral vertebra over the superior facet of the caudal vertebra was the primary or the nodal point of pathogenesis of the spinal degeneration.<sup>[16,17]</sup> Lifelong stresses on the muscles that support standing human posture and their misuse, disuse, or injury-related weakness were incriminated to be the primary causative factor. This is in variance with the century-old concept that “age-related” reduction of the water content of the disc and the related disc space reduction is the origin of the entire cascade of degenerative processes. We proposed a technique of “indirect decompression” by facet distraction. “Goel intra-articular spacers” were jammed into the articular cavity after distraction of the facets.<sup>[18,19]</sup> The procedure resulted in an enlargement of the spinal canal and root canal dimensions. “Decompression” of the nerve root and dural tube was achieved without any removal of bone, disc, osteophyte, or soft tissue. It was identified that a single surgical maneuver of facet distraction by intra-articular spacers could reverse all the pathological events that have been related to the degenerative spondylosis. We also identified that facet distraction has the potential of resorption of the osteophyte, can cause postoperative reversal of disc herniation, and can result in an increase in the “water content” of the disc.<sup>[16-20]</sup> Essentially, the technique was aimed to achieve segmental stabilization and arthrodesis without manipulation or resection of any bone, ligament, disc, or osteophyte. Other authors also identified the role of facet distraction in the treatment of spinal canal stenosis and ratified our observations.<sup>[21]</sup>

Herniation of intervertebral disc has been widely known to cause mechanical or physical compression and deformation of the neural structures (static factor). The general opinion is that a static factor that is related to neural compression plays a major or even a solo role in production of neural symptoms related to radiculopathy. Oblique profile and lateral location of the facet articulation that is away from neural structures make radiological identification of vertical spinal instability difficult or impossible.

As the understanding of the process involved in the spinal degeneration has further matured, it was observed that more than static factors related to neural compression or deformation, it is the subtle instability related repeated micro-injuries to the neural structures or dynamic factor that is the cause of symptoms.<sup>[22]</sup> On the basis of these observations, we resorted to “only fixation” as the mode of treatment of single or multilevel lumbar and cervical degeneration-related radiculopathy or myelopathy.<sup>[1-9]</sup> We reported our successful clinical outcome following “only

fixation” as the mode of treatment for cervical radiculopathy<sup>[1]</sup> and for cervical prolapsed intervertebral disc in patients presenting with symptoms of myelopathy.<sup>[3]</sup> Our earlier studies identify osteophyte formation as an event that is secondary to local and segmental spinal instability.<sup>[23]</sup> Accordingly, stabilization of the spinal segment was advocated in the event of the presence of osteophyte and compelling neurological symptoms. Such a surgical treatment was identified to eventually result in resorption of the osteophyte.<sup>[1]</sup> Direct surgical resection of the osteophyte for neural decompression was considered to be unnecessary.<sup>[23]</sup> Our increasing experience in the field suggests that neck and back pain and radiculopathy may be by themselves an evidence of spinal instability and treatment may be considered even when there is no corroborative radiological evidence of either root compression or manifest spinal segmental instability.<sup>[1-9]</sup>

During the period July 2014–October 2018, we resorted to segmental spinal fixation for patients having lumbar disc herniation-related radiculopathy. On exposure of the spinal segment, we identified a definite evidence of spinal instability on local inspection of facet joint and manual bone handling in all patients. Although it could not be confirmed, the extent of instability in cases of lumbar radiculopathy appeared to be significantly less when compared to instability associated with multilevel lumbar canal stenosis. It is unclear if spinal instability is the cause or the effect of herniated disc. Physical compression and distortion of the neural structures is obvious on imaging. However, relief following rest and immobilization or movement restriction by external orthosis despite the presence of neural compression suggests a role for mechanical instability or even movement as a cause of symptom and spinal stabilization as a potential treatment form. Instrumented fixation of the spinal segments provides internal firm immobilization. Direct observation of the facet instability guided by clinical presentation and radiological appearances formed a reliable means of identification of the unstable spinal segments and guided the number of spinal segments that needed stabilization. Our 35-year experience in handling the facets of atlantoaxial articulation and more than 13-year experience of handling subaxial spine assisted us in assessing and confirming the unstable spinal levels.<sup>[18,19,24,25]</sup> Accordingly, the number of spinal segments that were stabilized was determined by direct observation and by bone manipulation. Identification of osteophytes in the vicinity of facet articulation, hypermobility of facets on manual manipulation, unusually wide interfacetal or articular space, weak or absent articular capsule, and facet malalignment were indicators of instability. More than 1 level of facet fixation was done in 26 patients despite the fact that disc herniation- and adjoining osteophyte-related

neural compression was observed essentially at one level. Fixation of adjacent spinal segment was done when manual and visual assessments convincingly indicated the presence of instability. Despite this, our increasing experience in the subject is suggestive that for a single-level disc herniation, a single spinal fixation is sufficient and more than one-level fixation might not be necessary. Limitation of number of spinal fixation levels in the generally younger population presenting with acute disc herniation can circumvent the disadvantage of movement restrictions related to more than one level fixation.

The technique of transarticular screw insertion was as described by Camille in 1972.<sup>[10]</sup> The articular facets are largely cortical in nature and physically the strongest spinal component. The technically simple, safe, firm, and secure stabilization at the fulcrum of spinal movements provides solid fixation and a reliable background for bone fusion. We used our double-insurance technique wherein two screws or triple-insurance technique wherein three screws were inserted into each facet articulation.<sup>[11]</sup> These techniques provided additional strength to the process of stabilization. Biomechanical efficiency of facet transarticular technique fixation in providing immediate stability has been done previously.<sup>[26]</sup> As the disc was not directly resected, nerve root handling or manipulation and the possibility of its injury were entirely avoided.

In the presented series of patients with lumbar intervertebral disc herniation, clinical outcome following only fixation of the affected segments was remarkably (and probably unbelievably) effective. Most patients were relieved of the radicular symptom after reversal from anesthesia. Although there were no surgical failures and there was no need for any secondary surgery in the lumbar spine, all midline and even lateral surgical procedures were possible as a second-stage surgery, now without the concern about regional stability. We recommend the use of lumbar belt for 6 weeks after surgery. Most surgeons treating similar cases with lumbar discectomy do not suggest a need for such movement restriction after surgery. Follow-up observations showed resorption of the herniated part of the disc material in 29 cases and reduction in the size of osteophyte in 5 cases. Duration of follow-up being relatively small, the disc resorption was not clearly evident in 34% of cases, and bone fusion could be assessed primarily by observing the status of the facets.

Decompression of the compressed neural structures forms one of the basic tenants of neurosurgery. On the other hand,

our study suggests fusion of the spinal segments without any decompression. Considering the potential clinical implications of our observations, further prospective studies are warranted that have a larger cohort of patients. The drawback of the current study is that the number of treated patient cohort is relatively small; it did not have a control group, a double-blinded patient study format, and a scientific protocol. Although the validity of the proposed treatment will have to be assessed and confirmed with more experience and by other surgical groups, the successful clinical and radiological outcome is encouraging.

## CONCLUSIONS

Segmental spinal fixation that is aimed toward arthrodesis can be a safe and rational form of surgical treatment for prolapsed of herniated lumbar intervertebral disc.

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## Conflicts of interest

There are no conflicts of interest.

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